

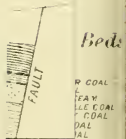
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ON

THE PRESENT STATE OF COAL MINING

IN THE COUNTY OF TYRONE.

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Read before the Royal Dublin Society, Monday,
November 18, 1872.

IN the County Tyrone, there are two small coal-fields, the larger of which possesses some interest, from a commercial, as well as from a geological point of view.

Of this coal-field, records are in existence which relate to workings carried on about a hundred years ago, while tradition carries us back to a much earlier period of mining enterprise there; but for at least a century, the coal has been continuously wrought, innumerable pits having been opened and a large quantity of fuel removed, without, however, benefiting to any appreciable extent any person concerned, save perhaps the owners of the royalties.

As the coal-field, although small in superficial extent, contains a great number of workable, and some valuable seams at a comparatively trifling depth, and many of them capable of being worked together by one shaft, while the total amount of available coal exceeds that in any other Irish field, except that of Leinster, it may be worth inquiring into the reasons which have hitherto prevented the workings being remunerative, although high prices are readily obtainable; fuel of all kinds being exceedingly dear on account of the rates charged for the carriage of coal inland from seaports, and an additional demand existing in consequence of numerous mills and factories being in operation all through the district.

It is not intended—nor indeed is it necessary—in this paper to

enter at any length into geological details of the coal-field.* But I shall give a short description of its resources, such as the remarks I am about to make on the manner of working require.

The coal-bearing country—uncovered by other strata—extends from near Dungannon to beyond Coalisland in a north-easterly direction, and is about $3\frac{3}{4}$ miles long. The greatest breadth is $2\frac{1}{2}$ miles, from a large boundary fault on the west to the edge of the New Red Sandstone formation on the east. As the shape of the exposed coal-measures forms a triangle, the area is about $4\frac{1}{2}$ square miles, or 3000 acres, but they continue under the Triassic beds for an unknown distance, and have been worked beneath them in several places: as yet however to a very trifling degree.

The lowest seams of coal are found within a mile and a half north of Dungannon.† First comes the “Monkey” or “Lower coal.” It is about two feet thick, and has been worked profitably at the outcrop. None of it is to be seen now, but the miners report well of it. Over this are from ten to thirty yards of strata, and then, the “Drumglass” or “Main coal.” This is a very good seam. Its average thickness is five feet, although it has sometimes reached eleven feet. It contains a band of shale or “clearing,” of variable dimensions, usually increasing, with the thickness of the seam, from one to six feet, and dividing the coal into the “top” and “bottom” coals. The former is a very good pure coal, comes out in large blocks, and is better than Scotch, but inferior to the best English coal. It contains iron pyrites or “sulphur,” but burns slowly and gives out a great heat, producing a reddish ash, but not in large quantity. It answers well for domestic purposes. The bottom coal is rather slaty and contains much ash. Both mixed answer admirably for steam coal. This is a free burning coal. The slack cakes well. At present the prices at bank are 25s. per ton for picked coal, 18s. for second quality, and 16s. for slack.

About forty years ago an extensive working was made on this coal towards the centre of the line of crop, where the quality is said to be best. The seam here was 4 feet $10\frac{1}{2}$ inches, viz.:—

	Ft.	In.
Top coal . .	1	$10\frac{1}{2}$
“Clearing,” .	1	0
Bottom coal, †	2	0
	4	$10\frac{1}{2}$

A pit 120 yards was put down, and a considerable amount of coal

* The geology of this coal-field has been already described, more or less fully, by several observers; Sir Richard Griffith's valuable report—“Geological and Mining Survey of Tyrone and Antrim”—is so well known as hardly to need a reference here; while in Gen. Portlock's “Geological Report,” &c.; and Sir R. Kane's “Industrial Resources of Ireland,” much information on this subject is to be obtained.

† Their outcrops can be traced from the boundary fault to the New Red Sandstone, a distance of two and a half miles.

removed. However, a series of accidents, combined with negligence on the part of the miners, led to its being drowned out; and no attempt has since been made on that part of the "Main coal." A large quantity still remains and would probably repay a well-managed enterprise. There are now but one or two small pits on this seam, and so small and in such positions as to be of little value.*

Nearly two miles of almost unproved ground lie between this outcrop and that of the next workable seam. This is a very valuable one. It is called the Greenagh coal, and is four feet six inches thick, including about twelve or fourteen inches of Cannel in the centre. This has been proved in various gas works to be equal to Lesmahagow, and much superior to Wigan, Cannel.† It now brings at bank from 45s. to 50s. per ton! the soft top and bottom coals, picked 26s., and slack 18s., while a kind of bituminous shale called "cracker," which lies between the Cannel and soft coals, helps in the engine firing; the cost of raising a ton of this seam is about 7s. 6d.; that is, for each ton of Cannel about 27s. There is only one colliery now working here, and it is situated near the outcrop. It appears to be fairly successful, so far. This seam has as yet been very little meddled with. The dip is towards the east under the Triassic rocks. There can be little doubt of the success of a deep pit sunk through those beds, and I believe that this coal, if not others, would be found at a workable depth even under the Tertiary clays still further to the eastward.

The Greenagh coal crops out across the Torrent River, nearly a mile south of Coalisland. If we follow the course of the river upwards for a little distance from this outcrop, and then strike over the country for a mile and a half, and through the village, we shall in that short distance traverse the edges of no fewer than eight coals, of a yard and upwards in thickness.‡ In that number there are four "yard" coals; two "5-feet," a "6-foot" with twenty inches of Cannel, and a "9-foot;" while interspersed amongst these are several small "Monkey coals" varying from ten inches to two feet thick, some of which have been worked, and found to be of good quality. All these seams lie in about 200 yards of strata; and it has been remarked by Sir Richard Griffith, Sir Robert Kane, and other authorities, that it is a rare, if not unknown circumstance, to find such a thickness of coal in such a trifling depth. These coals are all solid, with the exception of a few inches of "clunch" in some of them. They are often slaty, and on an

* The position, and extent to the dip—so far as can be yet made out—of the "Main" and "Monkey" coals is shown in the accompanying sections.

From the pit just referred to more than 190,000 tons were sold in ten years.

130 yards of strata have been "proved" over the "main coal."

† According to a report by Dr. Wallace, F. R. S. E., &c., Gas Examiner to the City of Glasgow, one ton of the Greenagh coal yields 11,500 to 12,000 cubic feet of gas, with an illuminating power of 34 standard sperm candles.

‡ In the entire coal-field *eighteen distinct seams* have been wrought on, at one time and another, comprising coals of from ten inches to nine feet in thickness; but in this Paper only those of a yard and upwards will be considered as of economic value.

average are hardly equal to the "Drumglass" coal, although some of them are better. Nearly all contain more or less sulphur. The measures here are much softer than those already spoken of; and in the upper beds, shales, fireclays, and slate, predominate.

There are ten known workable coals in the Dungannon coal-field, counting none worth notice that are less than three feet thick. They are usually called after the townlands in which they were first wrought. Here is a list of them in descending order* :—

Coalisland, or Upper-series.	{	Annagher coal, . . .	9ft.
		Strata, 13 to 18 yds.	
		Bone coal, ...	3ft.
		Strata, 9 to 13 yds.	
		Shining seam, ...	2ft. 10in. to 3ft.
		Strata 24 to 26 yds.	
		Brackaville coal, . . .	5ft.
		Strata, 16 to 32 yds.	
		Gortnaskea coal, . . .	6ft.
		With twenty inches Cannel.†	
		Strata, 25 to 35 yds.	
		Beltiboy coal, ...	3ft. to 3ft. 6in.
		Strata (with 4 coals), 40 to 60 yds.	
Relative position uncertain.	{	Derry coal, ...	3ft. to 5ft.
		Strata (with 2 coals), 50 yds.	
		Yard coal, ...	2ft. 10in. to 3ft.
		Strata, 80 yds. proved (with 2 small coals).	
		<i>Unknown ground.</i>	
		Strata, 30 yds.	
		Greenagh coal, ...	4ft. 6in.
		<i>Unknown ground.</i>	
		<i>Unknown ground.</i>	
		<i>Unknown ground.</i>	
		<i>Unknown ground.</i>	
		<i>Unknown ground.</i>	
		<i>Unknown ground.</i>	
Drumglass, or Lower-series.	{	Strata, 130 yds.	
		Main coal, ...	4ft. 10in. to 11ft.
		Strata, 10 to 30 yds.	
		Monkey coal, ...	1ft. 10in. to 2ft.

These are all bituminous or flaming coals. They have been wrought along the outcrop in a vast number of shallow pits, which have rarely exceeded thirty yards in depth. About a dozen have reached sixty or seventy yards, and five have actually exceeded 100.

* See Section No. 1.

† From specimens picked up at the old workings this appears to have been a fine Cannel. It was got out in such large blocks that the ordinary barrels would not contain them. They were, therefore, slung up in ropes.

The quantity of coal removed up to this has not been large when compared with the whole amount, and a considerable deposit still awaits the enterprising miner—but it has been taken away to a sufficient depth to satisfy local tastes. At Coalisland alone about one million tons have been taken out or spoiled, and, on a moderate estimate, there are at least twelve millions untouched, without taking into consideration the small coals under a yard in thickness; or the Greenagh seam which has as yet been wrought only in one small corner of its outcrop, and is entirely unproved elsewhere. It may be, and probably is, of some extent.

Of the Drumglass coal, lying near Dungannon, about one and a half million tons have been removed, and perhaps four and a half millions lie in that part of which anything is known. However, there is a wide strip of country between the latter and the first coal of the Coalisland series, of which nothing whatever is recorded, and which can hardly be said to have been explored at all. This debateable land comprises an area of nearly 1500 acres, and there is no reason why it might not contain productive seams of coal. Indeed, a few thin seams have been discovered close to the surface in the course of some imperfect and timorous trials, but nothing like a fair examination has ever been made, and the existence, everywhere, of a thick coating of drift, prevents the possibility of making out anything about it without having recourse to a good deep borehole.

In the above estimate, only the amount of coal lying in the uncovered coal-measures have been considered. This area is about 3000 acres, and the quantity of coal untouched there, about sixteen millions of tons. But under the New Red strata it is possible that the coals lie within a workable depth over an area of, at least, 2500 acres, which would give nearly sixteen millions more.* So that the whole available resources of this district may be put down as at least thirty millions. Professor Hull estimates the available tonnage at thirty-two millions.† It appears, therefore, that the Dungannon coal-field is second in resources amongst Irish ones.‡ This is very remarkable when the small comparative area of it is remembered.

In the section (No. 2), I have endeavoured to show the general sequence of the coal seams from end to end of the field; to show the relative extent of proved and unproved ground, and to compare the depth to which the coal has been worked with the ground which is yet untouched. The diagonally-lined band represents the depths to which the workings have been carried, that is, on an average about 200 feet, and indeed seldom so much. It will be seen that about 400 feet more would pierce through all the coals of the upper series where they come together towards the north-east, and that further back towards the

* Or if we cared to go down so far as English miners, probably a much larger quantity.

† Report of Royal Coal Commission (1871), Vol. i., p. 78.

‡ See Estimates of Irish Coal Fields, *loc. cit.*

outcrop pits of moderate depth would command two or three good coals to a fair extent.

Those parts of the section shaded, and with black lines representing the coals, are the portions in which the respective coals have been proved, either directly or indirectly, to exist, *but in which no workings have yet been made*. The comparison between the portion wrought out and that remaining is instructive. The coals shown are the same as those in section No. 1, with the exception of the Creenagh coal, which is not cut across by the line of section.

The unshaded portion shows the unproved ground already referred to, and which constitutes a very considerable moiety of the coal-field. It is, in fact, nearly as long as that which contains the eight coals of the upper series, and, for aught that is known, might contain as many, or perhaps the same ones repeated. The few trials that were made here merely proved the ground to be coal-measures with coal-beds, and were too imperfect to show whether the latter are new, or some of those already known. One or two proper trials might show the resources of the coal-field to be much greater than is as yet supposed. There is a most extraordinary apathy, however, existing in Ireland with regard to such matters, or rather, a dislike to look for coal in the right place, coupled with an astonishing eagerness to make searches in impossible localities.

From some remarks dropped lately in the Board-room of the North Dublin Union on the subject of the Dungannon coal, it would appear that there is an idea floating abroad that Irish coals are never thick enough to be worked profitably; but this is quite erroneous with regard to all, and especially so respecting the Dungannon coal-field, possessing, as it does, ten coals, many of which are much thicker than seams often worked with advantage at a great depth in England.

Some four miles north of Coalisland is a small strip of coal measures, in which three coals have been proved. Two of these are very good, one being nine and the other three feet thick. These having been much wrought on, and the exposed coal measures being but of trifling dimensions—(about, perhaps, two hundred and fifty acres),—a very limited supply can be reckoned on from this—the Annaghone—coal-field. The coal-beds, no doubt, here also extend under the New Red Sandstone, which is seen on the south and east, and the Permian on the north-east; but until they shall be proved no opinion can be given as to their value.*

* This field has been untouched for many years; at present a trifling attempt is being made to re-open it; but from its position of little value.

The section proved in Annaghone is as follows:—

Strata, 57 yds.
Main coal, 6ft. to 9ft.
Strata, 25 yds.
Shining seam, 2ft. to 3ft.
Strata, 12 to 25 yds.
Coal, 1ft.

It is remarkable that the coal of the Dungannon district is characterized by an almost entire absence of fire-damp, or, as it is locally called, "fire." It has been only known to occur in two pits, one of which was very shallow, and the other, although the deepest in the field, was only thirty yards in coal-measures. The presence of the gas was marked in one instance by a fatal accident, and in other cases by burnings, more or less severe. Perhaps the numerous faults which cut through the strata permit of its escape, and give a kind of natural ventilation; but at any rate the miners have the great advantage of being able to work with a naked light, and of knowing little or no risk. Choke-damp is abundant, but as all the pits are very small it is easy to procure good ventilation. In the Annaghone coal-field fire-damp was very troublesome, and it was necessary to use safety lamps.

Water, although abundant, is not unusually so, and, with proper machinery, could be easily mastered. The chief annoyances to be met with are faults, which in some parts are very numerous; and among the upper measures a dominance of soft strata, which renders timbering difficult and expensive. However, by a judicious choice of the ground, the former could in a great many cases be avoided, and the latter embarrassment is not so unknown as to be necessarily alarming to the practical miner.

The total cost of working the coal here is sometimes rather high; but then the prices obtained are proportionally large. The former varies from 4*s.* 8*d.* (in small pits) to 6*s.* 6*d.*, or even 7*s.* 6*d.* per ton in some cases. This, I think, includes every thing, both expenses at bank and below, as well as Royalties. At Coalisland, where the coals are solid, the expense, per ton, ought to be less than at Drumglass, where a thick clearing has to be got rid of; yet the difference of strata, and, therefore, in the cost of timbering, probably balances this.

Further on I shall give such a detailed list of working prices as I have been able to obtain.

The price of coals last May ranged from 8*s.* to 15*s.* at the pit's mouth; and a very ordinary coal, if it were just removed from slack, brought 11*s.* or 12*s.* At these rates there was an unfailing demand, and a very much greater quantity than was turned out could be readily disposed of. Even here a fair profit could be made; but on the Cree-nagh coal the gains were much greater. The cannel selling at from 35*s.* to 40*s.*, and the soft coal at 12*s.* made a total of about 20*s.* per ton, and the working expenses were 6*s.* 6*d.*

Now, although the cost of working has hardly at all increased—for there were no strikes of any consequence—prices have risen enormously: for round coal 20*s.* to 26*s.* is demanded, and for slack from 15*s.* to 18*s.*,* so that the cost of this coal in Dublin would be about 32*s.* equal to that of the best English coal delivered! This fact illustrates one of the causes of the stagnation of affairs in Tyrone. It is sought

* As before mentioned, the Cannel now fetches 45*s.* to 50*s.*

to make up for backwardness in exploration, and want of energy, by asking an absurdly high price for the little coal that is got out; the consequence being that outside a circle of a couple of miles from the pit no one will have anything to do with the coal.* Surely with labour so much cheaper in Ireland we should afford to give a not superior commodity at an equal if not a smaller first cost.

The coal-field is extremely well situated as a centre of supply. It is within a reasonable distance of Dungannon, Cookstown, and other flourishing manufacturing towns. An excellent canal connects Coal Island with Lough Neagh, and cheap conveyance is thus provided to Portadown, Antrim, Lurgan, and thence by rail to Belfast and the northern parts of Antrim. Besides, there are many mills and manufactories of various kinds scattered about the country within easy reach—while many others might be created, as it were, by an increase in the facilities for obtaining fuel—so that the sale of all the coal that could possibly be raised is ensured, if sold at prices which would secure to the adventurer even more than a fair profit.†

When, with all these advantages of a large number of thick and good seams at a small depth; easy rates for raising them compared with the large prices obtainable; no fire damp to contend against; a first-rate market, and a native mining population; we see company after company breaking up in disgust, and the workings of private individuals becoming fewer every year, I think it will be agreed that there must be something radically wrong elsewhere than in the coalfield itself. I hope to be able to show that it lies altogether in the manner of working the pits here. And that if this valuable source of fuel were only properly managed, and wrought as it is deemed profitable to work even thin poor coals in other countries, the result would be very different.

At present Coalisland, instead of being a thriving town, full of life and industry, with such manufactures as the presence of a coal-field might naturally create, is a wretched tumble-down village, in which nothing seems to go on well. It contains three or four mills and tile works, and the ruins of several others, which serve for attestations of former mismanagement.

The style of mining is both antique and timid. When I first visited this district there was but one steam-engine working in it; but then there were only four pits open. Since then three other pits, on two of which engines are at work. Of all these, two are only 12 or 14 yards deep, and are worked by "Rolls," or winches; one is 40 yards, and is supplied with a horse-whim; and three, respectively 60, 70, and 90 yards, possess engines.

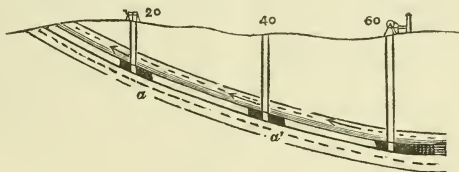
The great and crying defect here is the system of sinking shallow

* The largest out-put from any one pit, of late years, has been from 100 to 120 tons per week; and this only continued for a very limited period.

† The chief supply of fuel even for Coalisland itself is imported, for the quantity at present derived from the native workings is too insignificant to make itself felt.

shafts. There is no faith in the persistence of the coal seam, and there is a great dislike to sink a large sum of money at once on the chance of hitting on a good mine. The ground is therefore felt inch by inch downwards from the outcrop; but this caution does not altogether answer its purpose, the result often being that a considerable sum of money is expended uselessly, or, in fact, absolutely thrown away in this mistaken endeavour to save at the outset.

The plan adopted in laying out a pit is in most cases this. The locality is always selected so as to be at a very little distance from some old workings, in order that there may be no mistake; and a shallow pit is put down, say 20 yards. The winding and drawing apparatus for this consists of a hand-roll and buckets, which are wound by two men. As this pit commands a very short length of upsett, and the machinery would be unable to cope with the disproportionately large quantity of water which is always to be found near the outcrop of strata, if a long level were driven, the mine is soon wrought out. Another, and a deeper shaft, is then sunk to the dip. This may reach a depth of 40 yards, and is most likely unwatered by a horse-whim. It has hardly a longer term of existence than the other, and, on its conclusion, a third is begun still further to the dip, to the depth of 60 yards. Perhaps a small engine is set up here, but the days of the pit are numbered from the first, for if a trifling roll or "trouble" is met with, the miners lose heart and abandon the work. It is clear that the last would have removed all the coals to the outcrop had it been put down at once, as the following diagram will show:—



The arrows show the direction in which the coal is wrought from the bottom of each pit.
a a' Portions of coal which in subsequent workings must be left untouched, so as to prevent floodings from the old works.

But not only is the money expended on the former ones literally thrown away, but these now act as reservoirs for a large flow of water, which will come down on the new pit, and make the mining of the coal both difficult and expensive: yet it is almost invariably the rule.

The men have a great dislike to deep pits and long levels. They are not used to them; and they say that these coals are better worked, and more cheaply, by sinking shallow pits on them than by working long levels. The fallacy of this is, of course, apparent when it is considered that in sinking a pit so much useless material must be got

out, but that a level driven in coal *pays its way*.* However, as the owners depend altogether on the "practical knowledge" and experience of the working colliers, they continue to expend the money one shaft has earned in putting down another.

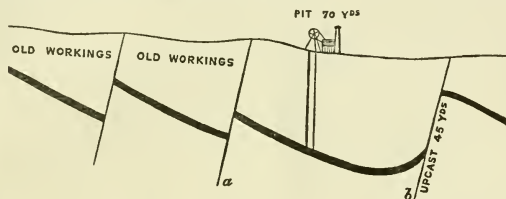
In this manner, and without the slightest improvement or alteration for, probably, the last two hundred years, the coals in the Dungannon district have been attacked, one by one, around the outcrop, and wastefully and unprofitably removed in bands of some 400 feet wide. Save in a very few instances, no pit has ever been used for the working of more than one coal. Although the seams preserve their relative distances with great regularity, and there is almost a perfect certainty of finding the next lower seam under any given one, the miners never dream of extending their shaft into lower workings, or even using it to look for the under coal when the upper has been exhausted, or fails. It sometimes happens that the coal which is sought after is bad, or thin, in a particular shaft, while 30 or 40 yards lower down a seam of excellent quality is attainable. But the poor seam is taken, and the other left. Now, in most places in the Coal-island division, a shaft of 100 yards would command at least three very good coals; and by distributing the expenses at bank over a greater quantity of coal, would reduce the mining prices to a very small sum per ton, and materially increase the profits; while by the present system of working with inadequate pits, repeated as explained above, the profits hardly more than balance the expenditure if the venture be continued for any length of time.

As a contrast to this mistaken cautiousness at the commencement, may be mentioned the waste and carelessness permitted in the actual getting of the coal. In the smaller pits it is, instead of being undercut, merely hewn down roughly. This, to begin with, spoils much of it. Then it is shovelled into a small "hurry" or sledge, which when dragged to the pit's mouth is emptied there with very little regard for the condition of its freight. A second shovelling then places it in the barrel in which it is drawn to the surface, where it arrives mostly as slack, and full of dirt, fireclay, and stone. It is only quite lately that even in the deeper pits tramways have been laid, and any sort of care bestowed on the carriage of the coal, which is all naturally tender, and easily broken up if much knocked about, or allowed to remain soaking in wet, or subject to being trampled on.

Another source of loss and disappointment is the want of knowledge, or rather forethought, displayed in the choice of ground. By a most unlucky coincidence hardly a pit of any size has escaped the proximity of one or more faults, which both deteriorated the quality of the coal,

* Moreover, it is only near the outcrop that the sinking of a number of small pits would be cheap. The coal so obtained would, therefore, be of bad quality, and could never be had in any quantity. Besides, with a shallow pit the expenses at bank are as heavy, for a small quantity of coal as would suffice for a much larger output. With an extensive working these are reduced to a minimum.

and made it profitless to follow. Thanks to the innumerable attempts at mining that have been made here, from what is called "hoking" at the surface to the more ambitious and usual limit of sixty yards, there are few places where so much information on such matters could be obtained. Yet what might be regarded as a kind of life-sized working plan has been in every case neglected. Some of the most considerable pits are sunk absurdly close to large faults, and can never be expected to make any reasonable return, whilst beside them are abandoned pits, the depths of which are known, and by comparison with each other show at once that there is disturbance. The amount could even be calculated to a nicety. One of the pits referred to was so unfortunate as to get into a perfect nest of faults and old workings. A section through it on the line of dip would be something like this:—



Faults (a) and (b) cut obliquely across the dip so as to shorten the levels, spoil the "upsetts," and prevent "downsetts" or drifts.

It would not be difficult to find many repetitions of this instance; but in every case the evil might have been avoided if a little consideration had been given to the matter, and if the here existing "rule of thumb" method of mining were discontinued. But so long as it is the practice to stick to localities which are honey-combed with the most palpable failures, so long will the money invested continue to disappear, returning neither principal nor interest.

The faults in this coal-field, although numerous, are not always of such magnitude as necessarily, when met with, to cause the pursuit of the working to be relinquished. In most districts they would be cut across, and the levels continued on the other side, when the seam should have been discovered there, if not displaced too much. But here this is seldom done. The direction of the level is altered so as to run alongside of the fault, and as the quality and thickness of the seam is often much deteriorated and reduced there, the miners get tired of following it up, for literally the "game" becomes "not worth the candle;" and a pit that perhaps would pay well is sacrificed for want of a little energy and knowledge.

This dislike to encounter the responsibility and difficulty incumbent on entering new ground operates so strongly in the neighbourhood, that a very great proportion of the mining attempts here are merely

confined to "robbing" the remaining pillars in old workings. These are often crushed into slack from so long sustaining the weight of the roof, and are so old that the coal is full of recent crystals of gypsum, calc-spar, and alum, as well as being stained deeply with oxide of iron. The coal, therefore, has a very unfavourable appearance, and so even deters people—who take it to be a fresh average specimen—from being willing to make a proper venture.

The workings differ in many particulars from those of English and Scotch collieries. Partly in consequence of the provisions of the Mines Regulation Acts not yet extending to Ireland, and partly on account of the small extent of the pits, those precautions for the protection of life which are compulsory elsewhere are not in force here.* Thus, each pit has usually only one shaft, which is sometimes divided by a midwall, or "brattice," into two equal portions, one for the haulage of coal, miners, &c., and the other for drawing up water; for, as pumps have been only tried in one case, the method in general use is to lift it either in barrels or boxes. On the whole, when an engine is employed, this way answers very well for the trifling undertakings here, although there is sometimes a good flow of water; but as the coals are not put out very rapidly—it being preferred to let the demand get ahead of the supply—one small engine of about twenty-five horse-power is quite adequate for all the work.†

In a few pits the coals, on being cut, are placed directly in the "bogie" which is to bring them to the surface. These bogies are small waggons containing from two to four cwt. In most of the pits the barrels are still used, to the great detriment of the coal, and much waste of time. They are the same as used in unwatering, and hold from one to one and a-half cwt.

In many parts of Coalisland it is complained that it is very difficult to keep shafts and levels in order for any length of time, owing to the softness of the measures there. Doubtless, a little more care and expense at first would greatly obviate this. It would be well worth while to put down a strong, and properly tubbed shaft. It is important that the tubbing should be made as tight as possible; for as the water is taken up in open barrels and boxes, much of it is thrown against the sides: and, finding its way into the soft strata, causes them to swell with great pressure, so as even to crush in the timbers. This precaution is not always taken, and I believe the want of it would be

* It must be mentioned, however, that accidents are almost unknown in the district.

† There is no such practice here as "banking" coal. It is merely turned out as it is wanted, although there is rather a brisk demand. Usually a string of carts may be seen waiting each for its turn; the man last on the list, after waiting hopelessly, but perseveringly, for hours, often departing coalless, and it becomes, in fact, a matter of favour to obtain a ton of the precious mineral. Thus, an additional expense must be met by the consumer, who, if he lives at any distance, finds that he can procure his fuel cheaper and with less trouble from English pits.

found to be one of the chief reasons for the inconvenience referred to. There are many mistakes made in the securing of shafts, which an experienced man would set right at once.*

The same observations apply to the under-ground passages. In the lower measures the beds are for the most part sufficiently firm to allow of the coal being removed without much expense of timber. The measures here principally consist of sandstone and sandstone slate, with but little soft shale or fireclay.† But from the Beltiboy coal upwards the shaley beds predominate, and it becomes then hard to keep the roads and levels open for any length of time. Of course, with the shallow and limited pits that are yet in vogue, it would never answer to take any extraordinary means for supporting the roof; but it is a question whether it would not pay, in a large, deep pit even to tunnel at least the main levels. It is certainly only by using the best means and appliances known that mining here will ever be profitable. Any further attempt in the present barbarous and unscientific mode can only lead to disappointment and waste of money.

Ventilation is in all the pits extremely good, and it is perhaps somewhat due to this that fire-damp is so seldom observed. The good air is probably as much to be ascribed to the insignificant size of the works as to any excellence in the arrangements, which, although rude, present nothing particularly worthy of notice. They answer the purpose for which they are designed admirably. Furnaces are seldom or never used, the natural difference of temperature above and below is permitted to produce the effect.

In working the coals here the "pillar and stall" method is preferred. It is in most cases necessitated by the nature of the ground, as the roof is often very rotten. The pillars are usually six yards square; the roadways and levels six feet wide; the upsets four or five; but in some the levels are so very narrow that it is difficult to crawl through. The "long wall" system was tried in one pit, but failed, for there was no "rock" with which to build up walls for the keeping up of the mainways. Where it could be managed it would undoubtedly be the best way and the least expensive, for nearly all the coal could be removed, and the timber would be taken away as the work proceeded. It is likely that this system could be used very effectively in some of the lower coals, which lie interbedded with hard strata, more especially some of the thinner ones.

The coal is taken down entirely by means of the pick. The variety

* In fact, even the deepest shafts here have been constructed with a view to temporary use only, and levels the same; the instinct which prevails with regard to shallow workings being carried into practice in all. It is not astonishing, therefore, that frequently the pit has to be given up long before a fair amount of coal has been won.

† The timbers used are two uprights or "puncheons," with a "lid" or cross-piece at top, of six-inch trees sawn in half, placed eighteen inches apart from centre to centre. In some cases they must be placed at half that distance.

used is a short straight head, with a handle of thirty inches. With this the miner very slightly "holes" the seam, and then hews it down. In this way much of the coal is spoiled, the greater portion becoming slack. No wedges are ever used to bring down the coal in large masses.

The men work in two shifts of from 8 to 10 hours each, and these are so managed that the miners have equal turns of day and night work.

The smaller pits, of which a great number have been opened at different times, are worked in an exceedingly primitive fashion. A single shaft suffices. It is 4 feet square, and from 8 to 20 yards deep. The "tubbing" or lining, is constructed of as little wood as possible, and a good deal of heather, and is neither as ingenious nor so effective as the wicker work or wattle tubbing of the ancient Belgians. Across the top is placed a "roll," or winch, often very ricketty, which being turned by two men raises and lowers alternately a pair of barrels, suspended by a rope, and answering for every purpose; raising of coal, drawing of water, and conveyance of the men, who prefer this way to what they consider to be the less secure one of the steam-engine and wire rope. Pits of over 60 yards have been in existence quite lately with no better winding apparatus.

Sometimes the underground arrangements in these little pits are not at all bad, but in general carelessness and waste prevail. The coal is hacked down any way at all, and is churned into fragments ere it reaches the top. The want of proper unwatering machinery is generally fatal; as the men say, "the water beats them." Of course this is a state of things that cannot be avoided when, as often happens, the workings are undertaken by a few poor men who club together to share the labour and expense: but the same thing is being done every day by people who should know better, and should see that it is their own interest to have their apparatus on a proper footing. Winding is done by steam power at less than one-tenth the expense of horse-whims,* and tramwagons are considered to do the work of wheel-barrows in metalliferous mines at one-fifth of the expense.† How much more advantageous then must both be than the rude appliances in favour here. I believe that nearly all the coal that has been won in the vicinity of Coalisland has been got out by the expensive and barbarous way just described.‡

* Captain Vivian of Wheal Towan, &c. *Henwood's Metall. Dep.* Vol. i. p. 142.

† *Op. Cit.*, Vol. i. p. 143.

‡ One reason for this state of things is probably the ease with which an outcrop of coal may be struck on, owing, as well to the numerous seams as to their repetition sometimes by means of faults. When the workings are obstructed by a "trouble" it is thought to be the best plan to open a similar pit elsewhere. This too is due to the phenomena of faults being misunderstood. The idea is, that the coals lie in sets of distinct basins or "pounds," and that a "trouble" denotes the

I will now give a list of such prices as are in common demand in the district.

For sinking shafts, the cost per yard varies with the diameter of the shaft, the nature of the ground, and the presence, or absence, of water, or running sand. In rather hard sandstone, and sandstone slate, with a good deal of water, a shaft 11 feet by $5\frac{1}{2}$ feet cost:—

	<i>s.</i>	<i>d.</i>	
For the 1st 20 yards, . . .	10	0	per yard.
„ 2nd „ „ . . .	15	0	„
„ 3rd „ „ . . .	20	0	„

Thus adding half the cost per yard, of the first 20 yards, each time.

In somewhat similar measures two shafts were sunk (belonging to one pit) about twenty feet apart, and five feet by four and a-half in diameter.

The cost of each was—

	<i>s.</i>	<i>d.</i>	
1st 20 yards, . . .	7	0	per yard.
2nd „ „ . . .	10	6	„ „
3rd „ „ . . .	14	0	„ „

and so on.

Thus it costs proportionately more to sink a narrow shaft than a wide one: since there is less room to work in, the tools cannot be used so effectively.

When the coal is won the prices are as follows:—

	<i>s.</i>	<i>d.</i>		<i>s.</i>	<i>d.</i>	
Hewers get from . . .	1	6	to 1 8			per ton.
*Putters „ . . .	0	$6\frac{1}{2}$	to 0 7			„
Banksmen „ . . .			1 4			per diem.
Onsetters „ . . .			1 4			„
Enginemn „ . . .	20	0	to 30 0			per week.
Firemen „ . . .	9	0	to 11 0			„

The hewers and “putters” are paid by the wagon or “bogie,” or by the barrel or the ton. In some cases the hewers are paid *4d.* per bogie of 4 cwt., in others *4s. 6d.* per 20 bogies of 3 cwt. “Putters” get in some pits *1d.* per bogie of 3 cwt., in others they are paid by the

dying out, or out-cropping, of the seam under work. This opinion is very general, and is not confined to the illiterate; but it is a mistaken one. The general dip of the coal is persistently to the north-east or thereabouts; and though subordinate rolls occur, they never bring the coal to the surface so as to reverse the crop, save at the very extremity of the basin itself, and then only partially, and under the influence of a very powerful boundary fault.

* The boys who “put” or shove the tram wagons full of coal from the hewers to the bottom of the shaft.

shift of 8 or 10 hours, 2s. The manner of payment differs, but the rate per ton comes to about the same thing.*

To these wages must be added those of the manager and clerk, and the "captain," whose position corresponds somewhat with that of the "Doggy" in Staffordshire collieries. These necessarily vary with the quality of the mine, but they are small indeed compared with those obtained in similar berths in England. A smith is sometimes engaged, but all wear and tear of tools is made good by the pitmen.

These supply their own tools, candles, &c. As there is no dangerous gas, a naked light is always used. A great saving might here be effected by the use of lamps, instead of candles. It has been estimated that the difference is at least 50 per cent. in favour of lamps.†

Larch timber, six inches in diameter, costs about 10s. per ton weight. When the carriage is added, the cost for each ton of coal removed varies from 6d. to 9d. in ordinary cases. But in the main roadways the timber must be frequently renewed or added to.

About 8d. per ton must be allowed for coal consumed in the engine room.

Reducing everything to the cost per ton, the total working cost will vary from 4s. 8d. to 6s. 6d. When to this are added the royalties, the coal may be had for from 5s. 6d. to 7s. 6d. per ton.

Royalties range from 6d. to 2s. per ton on the different properties. The first is very reasonable, but the higher charges mostly prevail, and in many instances help to prevent the coal being sold remuneratively at such prices as would encourage a demand outside the immediate vicinity of the pits. In fact it is the interest of every one concerned to combine to produce such a result. There can be little doubt that a colliery in the Tyrone coal-field would prove a valuable investment if conducted on proper principles, and with a view to more than merely an immediate large profit. That there is a demand is proved by the enormous prices that are obtained.

It is thought by some that the working of iron mines in the county of Antrim may give an impulse to coal mining in Tyrone, by inducing the raising of coal for the use of the iron smelter. This, however, is rather a remote prospect. Most of the coal at present raised is quite unfitted for the production of fine metal, containing as it does a large percentage of sulphur.‡ I need not say that iron manufactured with such fuel would not be of the best quality. As the freight of ore to Scotland is not exorbitant, it is doubtful whether it would be worth while to purify the coal either by coking or washing processes. Still it is an important point, as affecting both coal mining and iron manufac-

* These were the usual wages up to last July. Since then there has been an increase of about 20 per cent. ; but the rates now vary so much in different pits that it is impossible to make out a table that will suit all the cases.

† Records of Mining and Metallurgy. J. Arthur Phillips and John Darlington. Page 241.

‡ Some of the seams are, however, comparatively free from it.

ture in Ireland. However, it will be time enough to think of it when a colliery has been got up sufficient to supply the local wants.

In conclusion, a few words on the manner of making trials, and boring, may be considered not out of place.

In making a trial for coal it is usual to begin by putting down a shaft for about 20 or 30 yards. For it is always hoped that coal may be obtained within that distance; and then the shaft serves both for the exploration and for raising the coal. It has besides the advantage of showing the nature and disposition of the strata passed through. If nothing has been got at the depth named, and it is determined to go on, a bore hole is commenced. Boring, as practised here, is extremely untrustworthy, and—unless a bed of coal is actually passed through—gives hardly any information worth getting. It is done according to the ordinary English system of well-boring—that is, by means of a common chisel-shaped borer, attached to iron stocks or rods, which is beat upon the rock whilst it is gradually turned round in the hole formed. This reduces the rock acted on to a state of fine pulp, which is from time to time withdrawn for examination, by means of a valved tube, called a “Sludger.” It is anything but an easy matter to judge of the character of the rocks from the specimens that are thus obtained; and it is certainly impossible to compare these with strata in the neighbourhood, so as to predict the approach to any particular bed of coal, so that those employed are often quite at fault.* In fact, it is a style of work that should never be employed for a trial.

The prices are as follows, the diameter of the hole being one and a half to two inches :—

	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
For the first 10 yds. . . .	3	6	to 4	0 per yard.
„ second „	5	3	„ 6	0 „
„ third „	7	0	„ 8	0 „

thus adding half the cost per yard for the first ten yards to the last price. This is the rate for soft strata.

When the ground is harder, the rule seems to be to give for each ten yards one and a-half times the rate per yard paid for the preceding ten. In this way the cost increases very rapidly.

	<i>s.</i>	<i>d.</i>
For first 10 yds. . . .	4	0 per yard
„ second „	6	0 „
„ third „	9	0 „
„ fourth „	13	6 „

At the first rate a bore of fifty-four yards was put down in sandstone and sandstone slate, for an average of 8*s.* 6*d.* per yard.

At the next rate a bore of seventy yards, in somewhat similar strata,

* To add to the confusion, the joints of the rods act as borers, and cut away portions of the upper beds, which become mixed with the mud at bottom, and make it more difficult of identification.

but containing beds of hard sandstone and coarse conglomerate, cost 12*s.* 10*d.* per yard.

Deep borings are seldom undertaken here, and at the rates calculated above are never carried beyond seventy or eighty yards. Both employers and men then prefer to commence working by the shift, or day.

The wages then become—

	<i>s.</i>	<i>d.</i>	<i>s.</i>	<i>d.</i>
Head borer, ...	3	0	to 6	0 per diem.
Second do., ...	2	0	„ 3	6 „
Labourers, as many as are required,	11	0		per week.

In all these cases the employers provide the tools, and make good the wear and tear.

Sometimes the following prices are given—

	<i>s.</i>	<i>d.</i>
For first 20 feet, ...	1	0 per foot.
After that „, first 10 „, ...	2	0 „
„ „, 2nd „ „, ...	3	0 „

And so on until the rate becomes 8*s.* per foot, when a new agreement is made as to the remainder.

This estimate is for hard rock, and the men provide the tools, smith's work, &c. It is only suitable for shallow wells, as, in a deep trial, it would run up to an enormous expense.

The method under notice should seldom be used, even for wells, and never for explorations. For the latter it is, I believe, almost useless, and the cost is simply money thrown away. I know of more than one case where the borers are in doubt as to whether they passed through a thick bed of coal or not; and their descriptions of the strata gone through are generally extremely loose. The tool for such work should be one like the crown borer of M. Kind, by which a core of rock can be taken up, and its character unmistakably determined. It is remarkable that this is not tried here, for not only is it quick and effective, but it is also the cheapest method known. By this system a bore of 200 yards can be put down for an average cost of less than £1 per yard. While, by the other way, the cost would probably treble this; if, indeed, it would be done for it—and, after all the trouble, expense, and time, the explorer would be, perhaps, no wiser than before.

If the Dungannon coal-field is ever to repay a mining enterprise, the attempt will only succeed if it be made according to modern and scientific modes. It seems to be thought a sufficient excuse for using obsolete and slovenly methods, that there are certain difficulties of strata, &c., to be overcome; whereas, this is the very best reason in the world for proceeding in such a way as experience in other localities has proved to be the most economical.

ON THE
OCCURRENCE OF GYPSUM IN THE KEUPER MARLS,
NEAR COAGH, CO. TYRONE.

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[Read before the Royal Geological Society of Ireland].

ABOUT three-quarters of a mile south of the town of Coagh, in the county Tyrone, and on the left bank of the Ballinderry river, during a fruitless trial for coal in the clays and shales of the Keuper series, under the impression that they were the shales or "metals" of the Coal Formation, the workmen came upon several irregular beds of Fibrous Gypsum.

Before I had an opportunity of visiting the place the work had been given up in disgust, but on going there later, it was plain from the amount of the mineral in the "spoil," as well as from the account given by those who had been employed in the undertaking, that a somewhat considerable quantity of gypsum must have been passed through. It was impossible to get accurate information as to the thickness of the deposit, those engaged in any boring operations in this part of the country being extremely careless of keeping proper records; but the following section given me by the borer a few days after the trial was brought to an end is probably approximately correct.

Sunk in	Test.
Clay, soil, &c., about	10·0
Alternating red and green shales or clay in thin layers,	80·0
Red and green laminated shales, containing many irregular beds of gypsum, in large lumps varying from 1 to 5 inches thick, ...	15·0
Total Sunk	<u>105·0</u>

Then bored in

Red and green variegated shales, containing gypsum still in some quantity, but apparently not so plentiful as in above, ...	175.0
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Total Bored and Sunk, ...	280.0
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The beds varied much in thickness in different portions. The specimens to be seen on the bank were sometimes slightly curved, the fibrous lines of crystallisation being often curved also, and mostly at right angles to the planes of bedding; but in some pieces the crystals which were then better developed, and acicular, lay parallel to the stratification. Some pieces were saccharoidal, but the greater number were of fibrous structure. The workmen say, that in the fifteen feet sunk through, there was a very inconsiderable thickness of the clays free from gypsum, and its presence impeded their progress very much. Mr. Duff of Coagh, in whose employment the men were, told me that he considered the gypsum to be quite as abundant on leaving off, as when the boring was begun; that is judging from the whiteness of the sludge brought up. On the same authority, I learned that a specimen of talc was obtained during the sinking. Had a borer better fitted for such explorations been used it is possible that other minerals, such as rock salt, might have been detected.

But for this trial it is hardly likely that the presence of gypsum would have been ascertained—however it might have been suspected, in this locality; for the gypsiferous beds where they rise to the south west are covered by dolerite, which having crossed the river some distance to the north of the boring, and there overlying hard white chalk, takes a sharp sweep round by the east and south, and crosses the river again, about fifty feet south west of the bore-hole, the strata in which the latter is sunk dipping to the N. W., at an angle of 10°. On the strike of these beds about 450 yards to the south-east, at a house on the east side of the county road leading from Kingsmill to Coagh, a well was put down to a depth of sixty feet in the red shales, in search of water, but no traces of gypsum were found there; this must be close to the boundary of the dolerite. Towards the north-west where the Keuper strata extend there is a thick covering of drift which renders examination difficult, but with careful search, the gypsiferous beds may probably be again discovered in that direction.

